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Most computer-based training (CBT) research has ignored variables other than the software itself. Yet other factors can influence achievement. This study explores the impact of interaction between the student and instructor when students work CBT in pairs. Compared to an earlier study in which such interaction positively influenced achievement when students worked CBT individually, instructor interaction had no effect on achievement in this study with 41 college-level business statistics students. Perhaps many of the social functions served by the instructor in the traditional classroom can be provided by a CBT partner. Implications of these results, including the role of the instructor and the responsibility of the software developer are discussed. (Contains 21 references.) (Author/SLD)

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THE EFFECTS OF STUDENT-INSTRUCTOR INTERACTION ON ACHIEVEMENT IN A DYAD COMPUTER-BASED TRAINING ENVIRONMENT

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PREFACE

This report describes the results of an experiment which examined the impact of student-teacher interaction on performance in a computer-based training assignment. For this experiment, the students worked in dyads (pairs).

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SUMMARY

This study examines the impact of interaction between student and instructor when students work in pairs on a computer-based training (CBT) assignment. An earlier study with students working individually on this same assignment showed that student-instructor interaction had a positive effect on performance. This study, however, showed no such effect. Perhaps many of the social functions served by the instructor in the traditional classroom can be provided by a CBT team partner. Implications of these results for instructors and software developers are discussed.

THE EFFECTS OF STUDENT-INSTRUCTOR INTERACTION ON ACHIEVEMENT IN A DYAD COMPUTER-BASED TRAINING (CBT) ENVIRONMENT

I. INTRODUCTION

Research in CBT (used here as a generic term for all types of computer-aided learning) has focused on comparing a CBT approach to a traditional instruction (TI) approach. This research has typically shown that CBT produces quicker learning and more retention than TI. However, there has been essentially no research done on performance within CBT. This is unfortunate because TI research has shown that many variables influence performance. One TI variable which has been shown to have a definite influence on performance is the behavior of the instructor.

In general, the role of the instructor in CBT has been neglected (Moore, 1988). However, in a review of a variety of CBT courses, McCombs et al. (1984) found that two factors were critical to both the success of the CBT system and also student performance. These were: (a) adequate opportunities for student-instructor interactions, and (b) the incorporation of group activities with individualized training.

The student-instructor interaction result is a significant finding since one of the most consistently reported positive TI instructor behaviors is frequent but short student-instructor interactions. An increase in student-instructor interactions produces an increase in achievement (Brophy, 1986; Brophy & Good, 1986; Rosenshine, 1983). Stephenson (1991) manipulated this variable and found that student-instructor interaction had a positive effect on achievement in CBT even when the interactions were not related to the CBT content. Interacting with the instructor had the most impact on low ability students. While high ability students did not seem to benefit from having the instructor interact with them, low ability students did. In that study students worked CBT individually. Based on the results, it does appear that the instructor may play a significant role in CBT.

The second McCombs dimension, group activities, is a dimension not usually present in CBT. Perhaps that is because CBT is typically conducted in a one student-one terminal environment. To explore the effect of group activities and the impact on student-instructor interaction, the present study was conducted with students working CBT in dyads.

The purpose of the dyad arrangement was to create opportunities for group activities. Justification for this comes from two sources. First, there is a body of TI literature on the effect of students working in groups versus working individually.

The group work has focused on the effect of cooperation versus competition. The consensus is that students working in small groups produce higher achievement than students working alone, especially in a cooperative setting (Johnson et al., 1985; Warring et al., 1985; Yager et al., 1985). The best size seems to be either two or three (Cox & Berger, 1985; Trowbridge & Durnin, 1984; Webb, 1987). There is also consensus that paired students should be of the same sex and have similar abilities (Dalton, 1990; Dossett & Hulvershorn, 1983; Hooper et al., 1989; Johnson et al., 1985).

The second justification for arranging students in groups for CBT comes from recent CBT research. There is general agreement that achievement of students working CBT in dyads or triads is equal to or surpasses achievement of students working alone (Carrier & Sales, 1987; Cox & Berger, 1985; Dalton, 1990; Dalton et al., 1989; Dossett & Hulvershorn, 1983; Hmelo, 1989; Johnson et al., 1986; Justen et al., 1990; Shull, 1990; Trowbridge & Durnin, 1984; Webb, 1987). "No study has reported significantly greater learning when students work alone (Webb, 1987, p. 195)."

This field experiment was conducted to further define the role of the instructor in CBT. The aim was to examine the effect of interaction between the student and instructor when students work CBT in pairs.

II. METHOD

Subjects (Ss)

The Ss were 41 business statistics students. For a class project, they used a computer spreadsheet package to perform statistical calculations. All Ss completed a survey to assess their personal computer (PC) and spreadsheet experience.

Experimental Materials

The CBT software consisted of a spreadsheet tutorial which was part of a larger commercial software tutorial package designed for an integrated spreadsheet-word processing-database program. The tutorial is basically linear and learner-controlled; however, Ss can repeat a lesson if desired.

The tutorial was modified to include just the introduction to the integrated package plus that portion of the software devoted to using the spreadsheet. The introduction portion (Part A) contained four lessons, and the spreadsheet portion (Part B) contained eight. The tutorials were run on Tandy 1000SX PCs. An exercise designed to test mastery of the spreadsheet tutorial commands was added to the experimental software. Since the students were students from a Business Statistics class, the

exercise used statistical calculations as the vehicle for testing spreadsheet mastery. So, the experimental material consisted of a CBT spreadsheet tutorial modified to include a statistics-based exercise. The statistics exercise was also worked on the computer.

Procedure

Ss were randomly assigned by spreadsheet/PC experience to one of two student-instructor interaction modes. Group I (n=22) received essentially no instructor-initiated interactions. All Group I interactions were initiated by the student and consisted of requests for help in overcoming an obstacle in the tutorial. Group II (n=19) experienced the same type of student-initiated interactions experienced by Group I. In addition, Group II was exposed to multiple instructor-initiated interactions.

All Ss in both groups worked the tutorial in pairs. Ss were assigned to work teams based on grade point average (GPA), college major, and gender. However, all Ss worked the statistics exercise individually.

Both groups worked the tutorial in three sessions. In session one, all work teams started on lesson 1A and worked in the tutorial for 75 minutes. In the second session, all teams started on lesson B1 and worked for 75 minutes. In the third session, all teams started on lesson B3 and worked for 40 minutes. Therefore, all Ss had one exposure to lessons A1 though A4 and repeated exposure to lessons B1 through possibly B8, the spreadsheet portion of the tutorial. Since each team went at its own speed, total individual subject time on task varied.

After 40 minutes on day 3, all Ss were given the statistics exercise. Ss worked individually on the exercise for 30 minutes.

During the startup period (the first 15 minutes of the first session), the instructor responded to all questions in both groups to insure that the Ss were properly logged into the tutorial. Later, for both groups, the instructor responded to all questions with one or more of three responses. These were: (1) "Try pushing the [ESCAPE] key;" (2) "Try pushing the [SPACE] bar;" or (3) "Re-boot the system and start over." The suggestions were given in sequence. For example, if "Try pushing the [ESCAPE] key," did not correct the problem, then the S was told to "Try pushing the [SPACE] bar." For Group I Ss, these suggestions were the only instructor-initiated interactions experienced after the startup period.

In addition to the interactions listed above, Group II Ss also experienced instructor-initiated interactions. In the first session, the instructor initiated four interactions with each S. In sessions two and three, the instructor initiated three and one

interactions, respectively. These were related to location of keys on the Tandy keyboard. For example, shortly before the Back Slash (\) key was needed in the tutorial, the instructor would tell the students where that key was located on the Tandy keyboard. Key location was explained and diagrammed in instructions given to all Ss. For most Ss, however, key location on the Tandy keyboard was a minor problem due to previous exposure to an IBM keyboard. Instructor-initiated interactions lasted between 5 and 10 seconds.

In no instance did the instructor provide information which was not available to all Ss elsewhere in the instructional materials. Also, in no instance did the instructor comment, provide feedback, or give praise on performance of the tutorial.

Dependent Measures

Two dependent measures were recorded. First, individual performance on the exercise was scored. Second, Ss recorded the spreadsheet commands they actually used while working on the exercise. Most procedures can be performed in more than one way. For example, a cell entry can be changed by an EDIT command or by simply re-typing the entry. Therefore, this second measure was recorded to assess how many different spreadsheet commands were actually used during the exercise.

III. RESULTS

An analysis of variance was performed on each dependent variable. The results are presented in tables 1 and 2.

There were no differences between the two experimental groups on either spreadsheet performance or the use of commands. Also, there were no sex differences, and no significant interactions effects. The only statistical difference was spreadsheet experience level. Not surprisingly, Ss with prior experience in the use of spreadsheets outperformed those Ss without prior experience on spreadsheet performance. They also used more commands.

Table 1

Spreadsheet Performance by Group and Experience
Analysis of Variance

Source	Sum Sq	DF	Mean Sq	F	Prob
Group	46.40	1	46.40	0.16	0.693
Experience	3838.93	1	3838.93	13.06	0.001
Group x Experience	1.12	1	1.12	0.01	0.951
Error	10873.98	37	293.89		

Table 2

Use of Commands by Group and Experience
Analysis of Variance

Source	Sum Sq	DF	Mean Sq	F	Prob
Group	21.41	1	21.41	0.28	0.598
Experience	317.83	1	317.83	4.20	0.048
Group x Experience	18.20	1	18.20	0.24	0.627
Error	2649.95	35*	75.71		

* 2 Ss did not complete a Use of Commands form

IV. DISCUSSION

In a previous study, Stephenson (1991) had found that student-instructor interaction had a positive effect on achievement. However, in that study Ss worked CBT individually. In this study where Ss worked CBT in pairs, instructor interaction had no effect on performance. Evidently, many of the social functions usually performed by the instructor when Ss work CBT individually are taken over and performed by the dyad partner. Moreover, instructor interaction did not have a noticably larger effect on those Ss without prior spreadsheet experience, a result reported by Stephenson (1991). Even in pairs of low experience Ss, the dyad partner provided the feedback, support, and social facilitation usually provided by the instructor in a traditional classroom.

These results emphasize the social nature of learning. For some students, learning is simply a social event. In the traditional classroom the instructor may provide most of the social functions. In individual CBT situations the computer cannot provide these functions. So, when Ss run CBT individually, student interaction with a human instructor has a measurable effect. When social functions can be provided by a team partner, however, the need for interacting with the instructor is reduced. The strength of a paired CBT arrangement may be that it permits and promotes social interaction.

V. IMPLICATIONS

The relatively short-term nature of the tutorial used in this experiment obviously limits the generalization of the results. Still, the results of this experiment suggest that the CBT environment in which students work individually may not be the best. Comparable achievement can perhaps be produced when

students work CBT in pairs. The numerical advantage of training students in pairs versus individually is obvious. However, if students are arranged in pairs, the CBT instructor will want to be properly prepared to function in a study team environment.

Another implication is that the CBT software may need to be written to acknowledge that more than one student will be working on the terminal. For example, the CBT software could be written to require more than one response at each step in the program. Most software developers probably come from a traditional classroom background and therefore develop software from that perspective. Software designed to be used simultaneously by more than one student is not the norm. CBT system designers may have to 'force' the software developer to take this new approach. However, there is little research on this dimension to guide the course designer or the software developer.

These results also question a frequent justification for CBT; that is, the potential for 1:1 interaction. It may be that a 1 student:1 computer environment is not comparable to a 1 student:1 instructor environment. Instead, it may be that, due to the availability of social interaction, a 2 students:1 computer situation is more comparable to the traditionally accepted ideal of 1 student:1 human instructor.

A final implication of this research is that transitioning to CBT does not automatically guarantee success. Many factors (to include the instructor) must be considered before a CBT system reaches its full potential.

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